DETERMINATION OF THE DIRECT CAPTURE CONTRIBUTION FOR ^{13}N(p,γ)^{14}O FROM THE ^{14}O $\rightarrow$ ^{13}N + p ASYMPTOTIC NORMALIZATION COEFFICIENT

Xiaodong Tang[a),b)], A. Azhari[b)], Changbo Fu[b)], C.A. Gagliardi[b)], A.M. Mukhamedzhanov[b)], F. Pirlepesov[b)], L. Trache[b)], R.E. Tribble[b)], V. Burjan[c)], V. Kroha[c)], and B. F. Irgaziev[d)]

[a)] *Argonne National Laboratory, Argonne, IL 60439, USA*

[b)] *Cyclotron Institute, Texas A&M University, College Station, TX 77843*

[c)] *Institute of Nuclear Physics, Czech Academy of Sciences, Prague-Řež, Czech Republic*

[d)] *Department of Physics, National University, Tashkent, Uzbekistan*

^{13}N(p,γ)^{14}O is one of the key reactions which trigger the onset of the hot CNO cycle [1]. This transition occurs when the proton capture rate on ^{13}N is faster, due to increasing stellar temperature ($\geq 10^8$ K), than the ^{13}N β-decay rate [2]. The rate of this reaction is dominated by the resonant capture through the first excited state of ^{14}O ($E_r = 0.528$ MeV). However, through constructive interference direct capture below the resonance makes a non-negligible contribution to the reaction rate. We have determined this direct contribution by measuring the asymptotic normalization coefficient for ^{14}O $\rightarrow$ ^{13}N + p. In our experiment, an 11.8 MeV/nucleon ^{13}N radioactive beam was used to study the ^{14}N(^{13}N,^{14}O)^{13}C peripheral transfer reaction and the asymptotic normalization coefficient, $(C^{^{14}\mathrm{O}}_{p_{1/2}})^2 = 29.0 \pm 4.3$ fm^{-1}, was extracted from the measured cross section. The radiative capture cross section was estimated using an R-matrix approach with the measured asymptotic normalization coefficient and the latest resonance parameters. We find the S factor for ^{13}N(p,γ)^{14}O to be larger than previous estimates [3]. Consequently the transition from the cold to hot CNO cycle for novae would be controlled by the slowest proton capture reaction ^{14}N(p,γ)^{15}O.

[1] M. Wiescher, J. Gorres and H. Schatz, J. Phys. G **25**, R133 (1999).
[2] M.S. Smith *et al.*, Phys. Rev. C **47**, 2740 (1993).
[3] P. Decrock *et al.*, Phys. Rev. C **48**, 2057 (1993).